

## Maxwell's Equations<sup>Ja1</sup>

In MKS units, and where  $\vec{D} = \epsilon \vec{E}$  and  $\vec{B} = \mu \vec{H}$ ,

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad \vec{\nabla} \times \vec{H} = \frac{\partial \vec{D}}{\partial t} + \vec{J}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \cdot \vec{D} = \rho$$

## Iron Dominated Magnets<sup>Fi1</sup>

In the absence of iron saturation the magnetic field in an iron dominated multipole magnet can be given to a good approximation in terms of the pole-tip field,  $B_{PT}$ , the number of ampere turns per pole,  $NI$ , and either the gap,  $g$ , or the inscribed radius,  $a$ , of the magnet. The results are summarized in the following table for dipole, quadrupole and sextupole magnets ( $\mu_0 = 4\pi \times 10^{-7}$  H / m).

Multipole	$B_x(x, y)$	$B_y(x, y)$	$B_{PT}[T]$
Dipole	0	$B_{PT}$	$\frac{2\mu_0 NI}{g [m]}$
Quadrupole	$\frac{B_{PT}}{a} y$	$\frac{B_{PT}}{a} x$	$\frac{2\mu_0 NI}{a [m]}$
Sextupole	$\frac{2B_{PT}}{a^2} xy$	$\frac{2B_{PT}}{a^2} \frac{(x^2 - y^2)}{2}$	$\frac{3\mu_0 NI}{a [m]}$